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**LEUROGNATHUS MARMORATA, A NEW GENUS AND SPECIES OF
SALAMANDER OF THE FAMILY DESMOGNATHIDÆ.**

BY J. PERCY MOORE.

The family Desmognathidæ was established by Prof. Cope for the American genus *Desmognathus*, of which four species are now known. Boulenger associated with *Desmognathus* the Mexican genus *Thorius* (which Cope had regarded as constituting a distinct family), a view which was later accepted by Cope. Stejneger has added a third genus, *Typhlotriton*, an interesting blind salamander which occurs in the caves of Missouri.

Among some salamanders collected by me in the mountains of North Carolina are three specimens of a fourth genus which is now described.

LEUROGNATHUS gen. nov.

With the osteological characters of the Desmognathidæ; vertebrae opisthocelous; carpus and tarsus cartilaginous; snout very flat, broad and depressed; palate not at all vaulted, but very flat and smooth; premaxillary bones completely coössified, not perforated by a fenestra; internal nares widely separated, much further apart than external nostrils; lungless. These characters are exhibited in the figures of the skull, Plate XIV, figs. 4, 5, 6 and 10.

***Leurognathus marmorata* sp. nov.**

Diagnosis.—Palatine teeth entirely wanting; thirteen costal grooves between the axilla and the groin; appressed limbs fail to meet by the width of about two costal interspaces; body stout, depressed; tail finned, its length about five-elevenths of entire length; digits well developed; color buff or ashy, marbled with black.

Description of male type.—Form rather robust, body depressed, widest in middle, but becoming nearly quadrate at the insertion of the hind legs, where the width becomes considerably reduced ventrally, while a thick welt overhangs the bases of the thighs dorsally. A distinct median dorsal groove extends from the occiput to the base of the tail, meeting the successive pairs of costal

grooves, which are conspicuously developed and extend without break from median ventral to median dorsal lines. Between the origin of the fore and hind limbs there are thirteen pairs of these, the first being directly over the axilla, the thirteenth inguinal. A fourteenth lies directly over the axis of the femur when the leg is extended at right angles to the body. Anterior to the axilla are two more incomplete grooves close together. Somewhat irregularly developed and ill-defined intermuscular grooves are continued for the greater part of the length of the tail.

The tail is five-elevenths of the entire length, quadrate at the base, where it is broader dorsally than ventrally. While the height remains nearly constant till near the end, the thickness decreases rapidly, so that the posterior two-thirds are decidedly compressed. The extreme end of the tail is slightly bent up and terminates in a little compressed tubercle. A prominent dorsal fin-fold occupies rather more than its posterior half, reaching its greatest height sixteen millimeters from the tip. Its free margin is irregular and ragged, the result apparently of wear. A low dorsal fold continues the fin-fold forward on to the base of the tail. A much narrower ventral fold, which is highest posteriorly, extends almost half the length of the tail.

The limbs, especially the hind pair, are well developed. When appressed to the sides of the body the fore limbs reach to a point about half-way between the fifth and sixth costal grooves (counting from the axillary), and the hind limbs similarly appressed reach cephalad of the eighth costal groove, so that the extremities of the two limbs are separated by two costal spaces. The fore limbs are slightly depressed, the digits are long, slender and entirely free; they increase in length in the following order: i, iv, ii and iii, the number of phalanges being respectively 1, 2, 2 and 3. Each digit is terminated by a slightly enlarged dark-brown horny nail which is particularly conspicuous on digit i. No distinct palmar tubercles are developed, but there is a deep groove extending from between the second and third fingers, meeting a curved depressed line which crosses the palm.

The pes is large, broad and flat, with a small first digit and the others long, slender, free and somewhat flattened. Digit i is less than one-half the length of v, then ii, iv and iii become successively longer, but iii and iv are nearly equal. The number of

phalanges composing the digits from i to v is respectively 1, 2, 3, 3 and 2. Like those of the hand, the pedal digits bear dark-colored horny tips. Distinct tubercles are absent, but grooves corresponding to those of the manus are present.

The form of the head is very characteristic, the snout being more flattened than in any of our smaller salamanders; its middle part has no evident curvature whatever. Outside of a line joining the anterior angle of the eye to the corresponding nostril it slopes gently downward, causing a faintly marked canthus rostralis, but the profile continues straight to a point between the nostrils, anterior to which it bends sharply downward into the alveolar margin of the jaw. The outline of the snout is a smooth regular curve with a just suggested angle below the nostrils; anteriorly it projects slightly beyond the lower jaw. The nostrils are small but, being surrounded by a raised fold and connected with the margin of the jaw by a groove, are conspicuous. They are separated by a distance about equal to the cleft of the eye.

The cleft of the mouth is slightly sinuous, and above its angle is a rounded elevation bounded behind by a well-marked vertical groove and above by a branch of this groove which is directed toward the eye. There is no conspicuously swollen parotid region and the posterior part of the head is smoothly rounded. The low but well-marked gular fold is, in this example, perfectly straight and is almost continuous on the sides of the neck with a faint dorsal groove.

One of the most striking features of the species, though not diagnostic among its allies, is the prominence of the rather large eyes, which in the living animal are very conspicuous. This results not so much from their size as from the flatness of the snout which forces them to stand out above its surface. Both the anterior and posterior angles present small tubercles, while behind the posterior is a distinct vertical curved fold—a spur from the lower eyelid, which is much broader behind. The upper eyelid about equals the interorbital space in width.

The vent is a narrow longitudinal slit about as long as the diameter of the thigh and situated in the base of the tail. Its margins are smooth and unmodified. The surface of the skin is generally smooth, but on the snout is slightly pitted and papillate.

Three series of dermal sense organs are present on the trunk, the middle one being best developed and most complete. It begins

above the axilla, and may be traced about half-way along the tail. The segmental organs are generally one near the anterior border of each costal fold, though some of the anterior somites present two. The dorsal series is very incomplete and disappears on the tail and middle trunk region. The ventral series of sense organs is complete on the trunk somites, several of the anterior and posterior of which are provided with two organs each. On the sides of the head a number of pores are aggregated in a rather large patch behind and below the angle of the mouth. They are arranged more or less into rows and are connected by a transverse line across the occipital region. A line of pores extends forward along the lower jaw and a shorter one on the upper jaw.

The color pattern is rather characteristic. The ground color is a decidedly yellowish buff, everywhere more or less thickly marked, except on the ventral surface, with irregular confluent blotches of black, sometimes distinct, sometimes obscure. On the parietal, frontal and rostral regions the ground color strongly predominates, while the whole occipital and nuchal regions are heavily blotched. On the base of the dorsum of the tail the color pattern takes the form of large blotches of the ground color in a network of black. Extending on to the sides of the body and tail the two colors become interdiffused, producing a gray color with small light yellow specks. The ventral surface is pale yellow, largely pure, but becoming clouded on the tail, pelvic region and throat. The dorsal and ventral surfaces of the limbs are colored respectively like the corresponding surfaces of the body. The toes are tipped with brown.

Of all regions the palate has the most characteristic appearance. Inside of the narrow vertical alveolar margins of the jaw which bound it, it presents a broad, perfectly smooth, unbroken and almost flat surface—a low unarched roof to the mouth. There is no shelf or fold of the integument within and parallel to the alveolar margin, no median pit and no trace of palatine teeth, the region usually occupied by the latter being perfectly smooth and flat. More remarkable still are the choanæ. These are minute slits lying between the anterior outer margins of the orbits and the maxillary tooth line, and consequently diverging posteriorly, where they are separated by a distance twice that between the external nares.

The tongue is broadly reniform, presenting a median longitudinal depression and some irregular wrinkles. Its margin is smooth, but the greater part of the upper surface is thickly covered with slender papillæ, forming a plush-like surface. The lateral and posterior margins are free, the anterior attached in the middle. The pedicle of attachment is triangular in section, its broad part corresponding with the anterior margin, and its apex with the posterior emargination.

The female type specimen is larger and more robust, with a shorter tail and broader, more flattened head. The snout is especially broad and flat, its width on a line with the anterior angles of the eyes being twice its length anterior to that line. The canthal tubercle is almost obsolete. The gular fold is distinctly curved forward. The appressed limbs are separated by slightly more than two costal interspaces. There is but one groove anterior to the axillary. The dorsal series of sense pores is better developed than in the male. The colors are duller and less pure in this example. The ground color above is buff, large blotches of which alternate with still larger blotches of a purplish black on the dorsal surface. These blotches are largest at the base of the tail and pelvic region, but on the head break up and become intermixed. Below, the color is very generally a dull yellowish ash.

A second female example, used for dissection and for the preparation of a skeleton, was similar to the last, but had two preaxillary grooves, as in the male specimen first described. This species exhibits in its skull many peculiarities which readily distinguish it from any of the described species of *Desmognathus*, in which the cranial characters are remarkably uniform. *Thorius* is clearly separated by the very large size of the nostrils which encroach largely upon the consequently very narrow premaxillary, by the high, narrow and strongly convex snout and by the ossified carpus and tarsus. The skeleton of *Typhlotriton* has not been described, but in the arched palate and position of the choanæ, etc., this genus approaches *Desmognathus*, from which it is chiefly distinguished by the strongly developed curved series of palatine teeth and the deep-sunken functionless eyes.

In *L. marmorata* the orbits are large and cause much of the great relative width of the skull, while the interorbital portion of the brain case is comparatively narrow. At their widest part the

frontal bones are less than the transverse diameter of the orbit, while in *Desmognathus* they equal or exceed this measurement. On the other hand, the parasphenoid width is greater in the present species, its interorbital portion being distinctly flattened instead of strongly rounded or even ridged as in *Desmognathus*. Consequently a section of this region is quadrate in *Leurognathus* and nearly triangular in *Desmognathus*. A strongly marked raised line crosses the parasphenoid at the posterior margin of the dentigerous plates and joins the periotic process on each side; this is wanting or inconspicuous in *Desmognathus* and in any case does not reach the periotic process.

The snout is perfectly flat between the just evident canthi rostrales, and the profile is straight from the posterior margin of the orbits to the sharply decurved alveolar margin of the jaw, giving this salamander a physiognomy very different from that of the species of *Desmognathus*, in which there is a strong longitudinal as well as a transverse curvature to this region. The entire roof and floor of the nasal chamber are closely approximated, resulting in a remarkable shallowness of the passages and a similarity in the form of the palate and snout. The completely coalesced premaxillaries are broad throughout, being nowhere less than one and one-half times the diameter of the nares, while the breadth between the latter is more than twice their diameter. At the frontal suture the premaxillary is truncated and overlaps the frontal, not bifurcated to embrace the mesial process of the latter as in *Desmognathus*. The premaxillary fontanelle, so conspicuous in *Desmognathus* and other genera of salamanders, is entirely closed, its position being indicated only by a slight depression. The external nares are small and separated by a distance of at least twice their diameter.

Extensively developed vomero-palatine bones constitute most of the roof of the mouth, and as they join the premaxillary and maxillaries with perfectly flush joints, the palate is given that strikingly smooth, flat and unbroken appearance which suggested the generic name. There is no trace of the deep median groove which separates the two halves of this bone anteriorly in *Desmognathus* and communicates (usually above a narrow bridge of bone) with the premaxillary fontanelle. These bones are united with the

premaxillary for the whole width of its palatal surface. The internal nares are inconspicuous narrow slits situated close to the anterior margins of the orbits at the extreme posterior outer angle of the vomero-palatines and extending into the palatal plates of the maxillaries. The actual choanae correspond to the outer ends of these clefts and are consequently very widely separated, a condition very different from that found in *Desmognathus*, in which the clefts cut deep into the vomero-palatines and expand at their inner ends into conspicuous openings, which are the choanae.

The parasphenoid teeth are borne on a pair of long, slender and pointed dentigerous plates, which are placed together as a sagittate area, posterior to the middle of the orbit. Each plate bears about eighteen or twenty oblique rows of minute teeth, each row containing from five to twelve teeth. There are about one hundred and twenty jaw teeth above and an equal number below, about fifteen being borne by the premaxillary. All of these teeth are set on the inner face of the alveolar flange and have simple, blunt, slightly compressed and undivided crowns. In the posterior part of both jaws they become smaller and more crowded. In the specimen dissected the posterior cranial region, the pterygoids and the branchio-hyal apparatus are essentially as in *Desmognathus*. There are sixteen presacral, one sacral and twenty-four postsacral vertebræ.

The visceral anatomy resembles in its general features the three species of *Desmognathus* which I have studied. There is no trace of lungs, and it may be added that lungs are entirely absent in *Desmognathus nigra* and *D. orchropaea*,¹ in which this deficiency has not previously been noted.

The three examples of this species above described, being all that have been taken, were found in a large clear rocky pool beneath a waterfall of a stream on the south flank of Grandfather Mt., N. C., and at an elevation of about 3,500 feet. From what observations were made they seem to be essentially aquatic, remaining in the deeper parts of the pool and not burrowing beneath stones in places merely wet, as does the *D. nigra*, which occurs in great numbers in the same region. *L. marmorata* is much less

¹The examples of this species which Wilder originally described as lungless have more recently been identified as belonging to the species *Spelerpes bilineatus*.

active than the latter species and swims rather sluggishly, but with an easy gliding motion. The individuals seen seemed rather shy, and when alarmed quickly took refuge under the large rocks scattered through the pool, from beneath which, however, they were easily induced to emerge by the attraction of pieces of meat or worms thrown into the water.

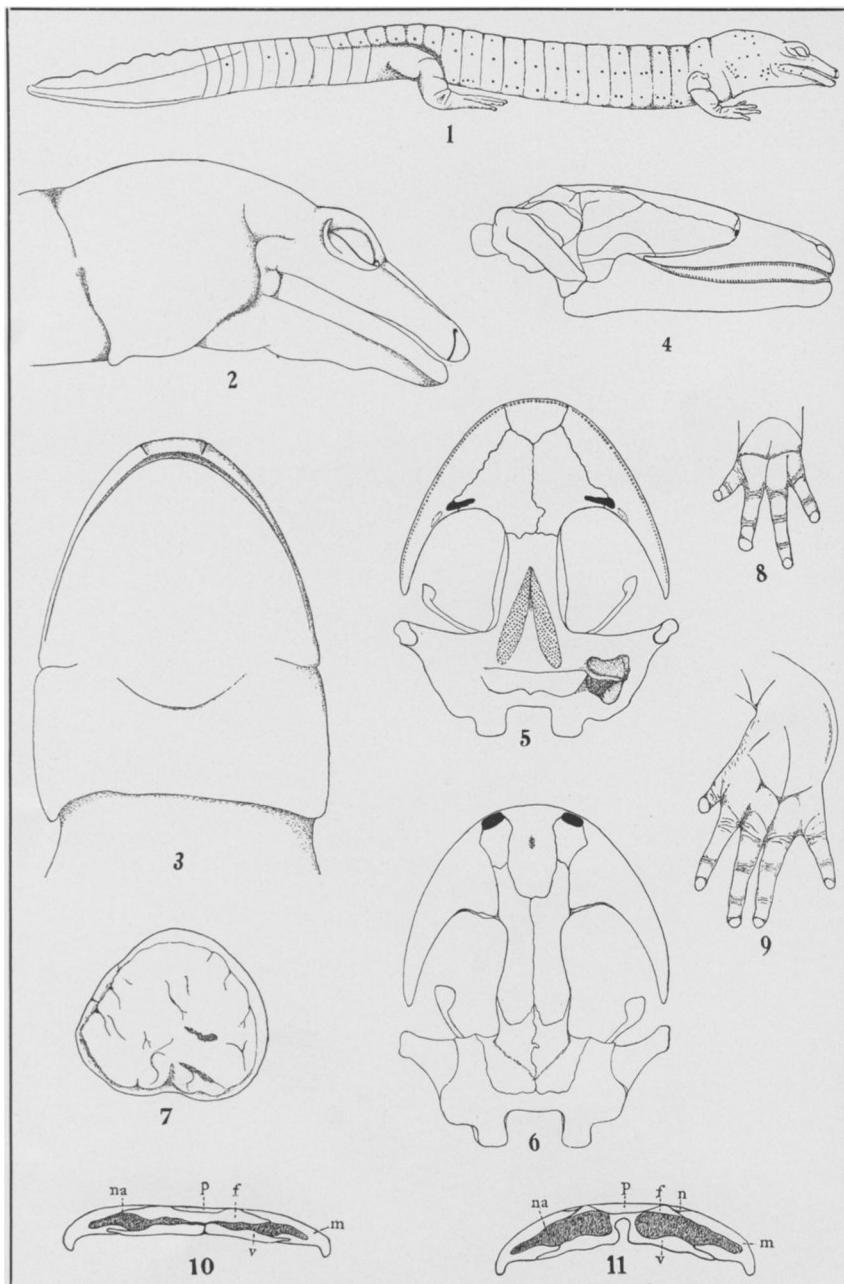
Measurements in Millimeters.

	TYPE ♂.	TYPE ♀.	♀
Total length.....	98.	108.	117.
Tail, from posterior margin of thighs.....	45.	47.5	51.
Head, from gular fold to end of muzzle.....	13.5	14.	15.
Snout, from anterior angle of eyes.....	4.2	4.4	4.5
Width at anterior angle of eyes.....	7.6	8.5	9.5
Width at posterior angle of jaws.....	9.5	11.	11.
Width at gular fold.....	9.5	10.5	10.5
Depth at tip of snout, approximately.....	1.8	2.3	2.
Depth midway between eyes	3.1	3.4	3.5
Depth midway between angle of jaws.....	4.7	5.	5.
Depth at gular fold.....	6.	7.	7.
Entire length of arm and hand.....	12.	13.	14.
Entire length of leg and foot.....	16.6	17.	18.

EXPLANATION OF PLATE XIV.

Figures 1 to 10, *Leurognathus marmorata*.

- Fig. 1. The male type, showing the external features from the side. The position of the lateral line sensory pores is indicated by small circles. Natural size.
- Figs. 2 and 3. Lateral and ventral views of the head of the same specimen. $\times 3.2$. In fig. 3 the nostrils are slightly too close together.
- Figs. 4, 5 and 6. Lateral, ventral and dorsal views of the skull of a slightly larger female specimen. $\times 3.2$. The internal and external nares are blackened and the position of the actual choanæ in the entire head is indicated by a ring of dots in fig. 5.
- Fig. 7. Dorsal aspect of the tongue disk of the same female, showing a small area of the closely set papillæ. $\times 3.2$.
- Figs. 8 and 9. Palmar aspect of the fore and hind feet of the example represented in fig. 1. $\times 3.2$.
- Fig. 10. Section of the skull of the female represented in figs. 4-6, taken just anterior to the internal nares. $\times 3.5$. p, pre-maxillary; f, frontal; m, maxillary; v, vomero-palatine; na, nasal passage, which is represented by shading.
- Fig. 11. A similar section of *Desmognathus nigra*. $\times 3.5$. n, nasal bone; the remaining lettering as in fig. 10.



LEUROGNATHUS MARMORATA. MOORE.